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Natural Resources Conservation Service

Grazing Enhancement Activity - Monitoring

Monitoring
Monitoring is utilized to determine if current management actions are meeting management objectives and having the desired effect on natural resources. Monitoring is used to quantify effects of management or environmental variation, at a location, through time. Monitoring can be short term; for example, to quantify the amount of biomass removed during a grazing event. It can also be long term, such as to quantify changes in plant basal cover or vegetation structure.

The most useful monitoring programs help managers achieve long term management objectives by generating relevant data. It is essential to clearly define both management and monitoring objectives before designing a monitoring program. Once defined, the appropriate monitoring techniques and monitoring locations can be selected.

Establishing a monitoring program includes:

1. Defining management and monitoring objectives
2. Determining monitoring techniques
3. Selecting monitoring sites
4. Collecting and recording data
5. Interpreting data
6. Refinement of management strategy

Benefits
Monitoring can help managers understand how much benefit is derived from changes in grazing management or from investments in rangeland or pastureland improvements. Monitoring data is utilized to: (1) evaluate effects of past and present management, (2) confirm effective management practices, and (3) identify trends that can be used to predict future changes so management strategies can be adapted accordingly.

Criteria for Monitoring Enhancement Activity
This enhancement requires an operator to define monitoring objectives; determine appropriate monitoring techniques; determine location of monitoring sites; collect and interpret data; and refine management strategies, as needed.

Monitoring activities applicable to pastureland and rangeland:
Three levels of monitoring are available based on needs identified in monitoring objectives and monitoring intensity (semi-quantitative vs. quantitative).

Level 1 – Photo point monitoring
Level 2 – Photo point monitoring plus

- Step point transect

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Level 3 – Photo point monitoring plus one or more of the following monitoring techniques

Monitoring Techniques

- Line-point intercept - percent bare ground, litter cover, basal cover, and canopy cover
- Species Composition by plant production (total harvest, double sampling, dry weight rank, or weight unit estimate)
- Gap intercept - wind and water erosion susceptibility and weed invasion
- Soil stability test - water erosion susceptibility
- Belt transect - measuring perennial invasive plants and woody species
- Vegetation structure - visual obstruction and habitat structure for wildlife)

References:

National Range and Pasture Handbook – Chapter 4
ftp://ftp-fc.sc.egov.usda.gov/GLTI/technical/publications/nrph/nrph-ch4.pdf

National Cattleman's Beef Association – IRM Natural Resource Desk Record
http://www.beefusa.org/prodredbooksandothertools.aspx

Sampling Vegetation Attributes – Technical Reference 1734-4
http://www.blm.gov/nstc/library/pdf/samplveg.pdf

Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems
http://usda-ars.nmsu.edu/Monit_Assess/monitoring_main.php

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Intensity Level	Management Unit	Management Objective	Monitoring Objective	Monitoring Technique	Measurement Frequency
1	Field 1	Minimize land degradation risk and maintain or increase productivity.	Detect changes in woody plant encroachment	Photo point monitoring	Annually
3	Example	Minimize land degradation risk and maintain or increase productivity.	Detect changes in invasive plant encroachment and changes in bare ground for soil erosion risks	Photo point monitoring; line point intercept, gap intercept	Once every 3 years

Intensity Level	Management Unit	Management Objective	Monitoring Objective	Monitoring Technique	Measurement Frequency

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1. Photo point monitoring

This enhancement activity requires a photographic record of vegetation and soil conditions to supplement needed observations. Photo point monitoring involves establishing permanent photo points and returning annually to take photographs at these locations. Photo point monitoring provides a visual record of changes. Over time, these images will show a trend in resource conditions that can be used to guide management decisions.

Photo point monitoring does not establish the cause of changes in resource conditions. For example, photographs may show a trend of increasing bare ground, but the cause of the trend could be management practices or a natural event, such as drought. Photographs should be used in conjunction with other monitoring methods.

Every operating unit has a unique combination of soils, topography, vegetation, and management. Appropriate sites for photo point monitoring are, therefore, highly site specific. Representative photo points should represent the characteristics of a much larger area. For example, if you have several adjacent management units with similar soil, vegetation, and management, one photo point can be used to represent all of the units.

Required Elements:

- For each photo point, at least one close-up and one landscape photo will be needed. Close-up photographs show specific characteristics of an area such as soil surface, ground cover, or litter. Landscape photographs document broad changes in conditions over time.
- Photographs should be taken at least annually at the same time each year.
- Brief description of how data was utilized in refining management decisions

Procedure:

- Establish the photo point and mark with a brightly painted steel or wooden post.
- On the data sheet provided, briefly describe the photo point location and why the site was selected.
- For landscape photographs, record a compass direction to help position the camera for future photographs. If possible, include a landmark in the background or place a second permanent marker about 20 feet away from the photo point marker to line up the photograph.
- For close-up photographs, lay a frame at the desired location (next to the marking stake or within a few feet of the stake, if the area is disturbed by livestock). Two carpenter rulers can be utilized to create a 3 ft. X 3 ft. square frame. Standing over the frame, take a photograph looking down at the frame. Try to avoid casting a shadow across the frame when taking the photo.
- Be sure to include a photo ID card that is large enough to be visible in the picture identifying the date, photo point number, and pasture name and/or number.

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References:

National Cattleman's Beef Association – IRM Natural Resource Desk Record
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Sampling Vegetation Attributes – Technical Reference 1734-4
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Sample photo identification sheet

Pasture Name: _____

Photo Point ID: _____

Observer: _____

Date: _____

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2. Step point transect

Step point transects are a rapid method for quantifying soil cover and the potential for erosion. Plant canopy is the percent of the ground surface covered by vegetation. Bare ground is defined as soil not covered by vegetation, litter or rocks. Soil cover is related to the site's ability to protect the ground surface from wind and water erosion. As percent bare ground increases, the potential for erosion increases.

For each step point transect, at the beginning point, select a point in the distance along the direction utilized in the photo point landscape photo. Every two paces, record the presence or absence of cover at the tip of one boot. If cover is present, record whether the cover is vegetation, rock, or litter. Otherwise, record as bare ground.

Required Elements:

- Collection and recording of step point transect data (Example form provided. Other data collection forms providing similar information are acceptable. Below are resources providing additional information on procedures and data collection forms).
- Brief description of how data was utilized in refining management decisions

References:

National Cattleman's Beef Association – IRM Natural Resource Desk Record
http://www.beefusa.org/prodredbooksandothertools.aspx

Sampling Vegetation Attributes – Technical Reference 1734-4
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Step Point Transect

Date: _____ Observer: _____

Pasture: _____ Transect ID: _____

Step Number	Cover			Bare Ground	Step Number	Cover			Bare Ground
	Veg.	Rock	Litter			Veg.	Rock	Litter	
1					26				
2					27				
3					28				
4					29				
5					30				
6					31				
7					32				
8					33				
9					34				
10					35				
11					36				
12					37				
13					38				
14					39				
15					40				
16					41				
17					42				
18					43				
19					44				
20					45				
21					46				
22					47				
23					48				
24					49				
25					50				

% Vegetative cover = ____ vegetation points X 2 = _____%

% Rock cover = ____ rock points X 2 = _____%

% Litter cover = ____ litter points X 2 = _____%

% Bare ground cover = ____ bare ground points X 2 = _____%

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3. Line point intercept

Line point intercept is an accurate method for quantifying soil cover, including vegetation, litter, rocks and biotic crusts. These measures are related to wind and water erosion, water infiltration, changes in species composition and cover, and the ability of the site to resist and recover from degradation. The following vegetation attributes are monitored with this method:

- Canopy (foliar) and basal cover
- Bare ground
- Ground cover
- Litter cover
- Cover by species, plant type, or functional group

Required Elements:

- Collection and recording of line point intercept transect data (Example form provided. Other data collection forms providing similar information are acceptable. Below are resources providing additional information on procedures and data collection forms.)
- Brief description of how data was utilized in refining management decisions

References:

National Cattleman's Beef Association – IRM Natural Resource Desk Record
http://www.beefusa.org/prodredbooksandothertools.aspx

Sampling Vegetation Attributes – Technical Reference 1734-4
http://www.blm.gov/nstc/library/pdf/samplveg.pdf

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Line-point Intercept Data Form

Page _____ of _____ Shaded cells for calculations

Plot: _____ Line #: _____ Observer: _____ Recorder: _____

Direction: _____ Date: _____ Intercept (Point) Spacing Interval = _____ cm (____ in)

Pt.	Top canopy	Lower canopy layers			Soil surface	Pt.	Top canopy	Lower canopy layers			Soil surface
		Code 1	Code 2	Code 3				Code 1	Code 2	Code 3	
1						26					
2						27					
3						28					
4						29					
5						30					
6						31					
7						32					
8						33					
9						34					
10						35					
11						36					
12						37					
13						38					
14						39					
15						40					
16						41					
17						42					
18						43					
19						44					
20						45					
21						46					
22						47					
23						48					
24						49					
25						50					

% canopy (foliar) cover = ____ canopy pts (1st col) x 2 = ____ %

% bare ground* = ____ pts (w/NONE over S) x 2 = ____ %

% basal cover = ____ plant base pts (last col) x 2 = ____ %

Top canopy codes: Species code, common name, or NONE (no canopy).

Lower canopy layers codes: Species code, common name, L (herbaceous litter), W (woody litter, >5 mm (~1/4 in) diameter).

Unknown Species Codes:

AF# =	annual forb
PF# =	perennial forb
AG# =	annual graminoid
PG# =	perennial graminoid
SH# =	shrub
TR# =	tree

Soil Surface (do not use litter):

Species Code (for basal intercept)

R =	rock fragment (>5 mm (~1/4 in) diameter)
BR =	bedrock, M = moss
LC =	visible lichen crust on soil
S =	soil without any other soil surface code
EL =	embedded litter (see page 10)
D =	duff

**Bare ground occurs ONLY when Top canopy = NONE, Lower canopy layers are empty (no L), and Soil surface = S.*

Reference: Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems

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4. Species composition by plant production

Total annual production is an attribute that is difficult to quantify, but is important for management. Total annual production is one of the most important indicators of the biotic integrity of a site because plants reflect changes in resource availability, including water and nutrients, and because they respond rapidly to changes in disturbances.

Required Elements:

- Collection and recording of plant production transect data (Example form provided. Other data collection forms providing similar information are acceptable. Below are resources providing additional information on procedures and data collection forms).
- Brief description of how data was utilized in refining management decisions

References:

National Range and Pasture Handbook – Chapter 4
ftp://ftp-fc.sc.egov.usda.gov/GLTI/technical/publications/nrph/nrph-ch4.pdf

Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems
http://usda-ars.nmsu.edu/Monit_Assess/monitoring_main.php

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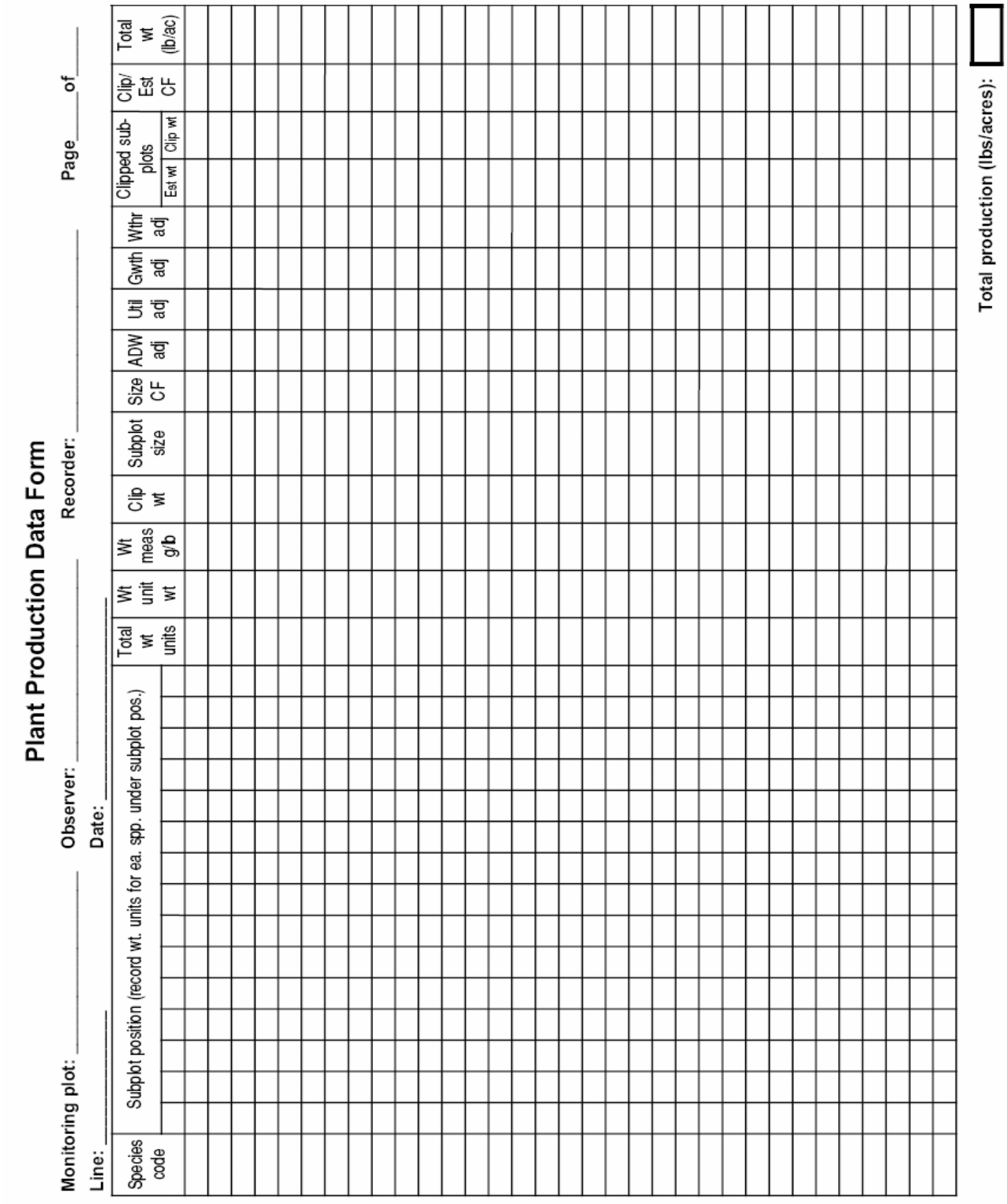

Reference: Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems

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5. Gap intercept

Gap intercept measurements provide information about the proportion of the line covered by large gaps between plants. Large gaps between plant canopies are important indicators of potential wind erosion and weed invasion. Large gaps between plant bases are important indicators of runoff and water erosion.

Required Elements:

- Collection and recording of gap intercept transect data (Example form provided. Other data collection forms providing similar information are acceptable. Below are resources providing additional information on procedures and data collection forms.)
- Brief description of how data was utilized in refining management decisions

References:

Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems
http://usda-ars.nmsu.edu/Monit_Assess/monitoring_main.php

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Gap Intercept Data Form

Monitoring plot: _____ Line: _____ Date: _____ Shaded cells for calculations

Reader: _____ Recorder: _____ Line Length _____ m or ft Page____ of _____

Circle one: includes only perennial vegetation OR includes annual and perennial vegetation

Canopy gaps: Minimum size = ___cm (___ft)							Basal gaps: Minimum size = ___cm (___ft)						
Starts	Ends	Gap (cm) size (ft)	25-50 1-2	51-100 2.1-3	101-200 3.1-6	>200 >6	Starts	Ends	Gap (cm) size (ft)	25-50 1-2	51-100 2.1-3	101-200 3.1-6	>200 >6
SUM (cm/ft)							SUM (cm/ft)						
LINE LENGTH (cm/ft)							LINE LENGTH (cm/ft)						
SUM ÷ LINE LENGTH							SUM ÷ LINE LENGTH						
			x 100	x 100	x 100	x 100				x 100	x 100	x 100	x 100
% of line in gaps							% of line in gaps						

Example: If SUM 25-50 = 1,573, Line Length = 5,000 cm, then % of line in gaps 25-50 cm = 100 x (SUM 25-50/line length) = 100 x (1,573/5,000) = 31.5%.

Reference: Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems

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6. Soil stability test

The soil stability test provides information about the degree of soil structural development and erosion resistance. It also reflects the soil biotic integrity, because the "glue" (organic matter) that binds soil particles together must constantly be renewed by plant roots and soil organisms. This test measures the soil's stability when exposed to rapid wetting. It is affected by soil texture, so it is important to limit comparisons to similar soils that have similar amounts of sand, silt, and clay.

Required Elements:

- Collection and recording of soil stability test data (Example form provided. Other data collection forms providing similar information are acceptable. Below are resources providing additional information on procedures and data collection forms.)
- Brief description of how data was utilized in refining management decisions

References:

Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems
http://usda-ars.nmsu.edu/Monit_Assess/monitoring_main.php

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Soil Stability Test Data Form

Monitoring plot: ____________________ Observer: ________________ Date: ______________

Recorder: ________________ Page _____ of _______

Veg = **NC** (no perennial canopy), **G** (grass or grass/shrub mix), **F** (forb), **Sh** (shrub), **T** (tree). **# = Stability value** (1-6). Circle value if samples are hydrophobic.

Surface

Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip	
Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#
		0:00	5:00				0:15	5:15				0:30	5:30				0:45	5:45				1:00	6:00				1:15	6:15	
		1:30	6:30				1:45	6:45				2:00	7:00				2:15	7:15				2:30	7:30				2:45	7:45	
		3:00	8:00				3:15	8:15				3:30	8:30				3:45	8:45				4:00	9:00				4:15	9:15	

Notes: ____

Subsurface

Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip		Line ___		In	Dip	
Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#	Pos	Veg	time	time	#
		0:00	5:00				0:15	5:15				0:30	5:30				0:45	5:45				1:00	6:00				1:15	6:15	
		1:30	6:30				1:45	6:45				2:00	7:00				2:15	7:15				2:30	7:30				2:45	7:45	
		3:00	8:00				3:15	8:15				3:30	8:30				3:45	8:45				4:00	9:00				4:15	9:15	

Notes: ____

Avg. Stability = Sum of Stability Rankings (i.e., #) / Total No. Samples Taken

Line	All samples		Protected samples (Samples w/Veg = G, Sh, or T)		Unprotected samples (Samples w/ Veg = NC)	
	Surface	Subsurface	Surface	Subsurface	Surface	Subsurface
Plot Avg.						

Reference: Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems

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7. Belt transect

The belt transect provides a way to measure the presence of invasive plants or woody seedlings. Belt transects provide a good means of monitoring brush or shrub encroachment.

Required Elements:

- Collection and recording of belt transect data (Example form provided. Other data collection forms providing similar information are acceptable. Below are resources providing additional information on procedures and data collection forms.)
- Brief description of how data was utilized in refining management decisions

References:

Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems
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Belt Transect Data Form

Monitoring plot: _____ Date: _____

Reader: _____ Recorder: _____

Transect area* = _____ ha = _____ meters X _____ meters/10,000
(line length) (belt width)

Transect area** = _____ ha = _____ ft x _____ ft x (0.0000093)

Size class A = _____ Size class B = _____ Size class C = _____

Density* = number of individuals per hectare (this indicator doesn't need to be calculated in the field).

Line:							Direction:		
	Size class								
Species	A (tally marks)	Total	Density	B (tally marks)	Total	Density	C (tally marks)	Total	Density

Line:							Direction:		
	Size class								
Species	A (tally marks)	Total	Density	B (tally marks)	Total	Density	C (tally marks)	Total	Density

Example: *50 m x 2 m = 100 square meters (m^2). There are 10,000 m^2 in 1 hectare, so 100 m^2/(10,000 m^2 per 1 ha) = 0.01 ha. Density for 15 plants in a 100 m^2 belt = 15/0.01 ha = 1500 plants/ha.
**150 ft x 6 ft = 900 ft^2. 1 ft^2 = 0.0000093 ha, so 900 ft^2 x 0.0000093ha/ft^2 = 0.008ha. Density for 15 plants in a 900 ft^2 belt = 15/0.008 = 1875 plants/ha.

Reference: Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems

Grazing Enhancement Activity - Monitoring

8. Vegetation structure

The vegetation structure method (robel pole, cover board) provides information on visual obstruction and habitat structure for various wildlife species. The technique is designed to evaluate changes in vegetation structure over time.

Required Elements:

- Collection and recording of vegetation structure data (Example form provided. Other data collection forms providing similar information are acceptable. Below are resources providing additional information on procedures and data collection forms.)
- Brief description of how data was utilized in refining management decisions

References:

Sampling Vegetation Attributes – Technical Reference 1734-4
http://www.blm.gov/nstc/library/pdf/samplveg.pdf

Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems
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Vegetation Structure Data Form

Monitoring plot: ________________ Date: ______________ Observer: ___________________ Recorder: _________________

Segment 1: ________m or ft? Segment 3: ________m or ft? Obs A = 5 m or 15 ft before Position, along the transect

Segment 2: ________m or ft? Segment 4: ________m or ft? Obs B = 5 m or 15 ft after Position, along the transect

Record a "1" if >25% of the band is covered/obstructed by vegetation. Record a "0" if <25% of the band is covered/obstructed.

$$\text{Visual obstruction} = 100\% \times \frac{\text{Segment total}}{\text{No. of obs.}}$$

Line:______		Position: ______		Position: ______		Position: ______		Position: ______		Position: ______				
Segment	Band	Obs A	Obs B	Obs A	Obs B	Obs A	Obs B	Obs A	Obs B	Obs A	Obs B			
1														
1														
1														
1												Segment total	No. of observations	Vis. obst.
1														
Total no. of bands														
2														
2														
2														
2												Segment total	No. of observations	Vis. obst.
2														
Total no. of bands														
3														
3														
3														
3												Segment total	No. of observations	Vis. obst.
3														
Total no. of bands														
4														
4														
4														
4												Segment total	No. of observations	Vis. obst.
4														
Total no. of bands														

Notes:

Average visual obstruction: ☐

Reference: Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems